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graphic plates reproduced in the papers referred to. It may be further pointed out that in minute spark gaps, such as are found useful in X-ray circuits, there is an oscillation which appears to promote the discharge. There is strong evidence which is being further examined, that these oscillations are due to an alternation of conduction and convection discharge across the gap. This involves a surging to and fro of the carriers, from one terminal to the other.

Faraday observed that there was no appreciable "electric wind" when a brush discharge becomes somewhat disruptive in character. He appears to have left Franklin's suggestion of a one-fluid theory wholly out of consideration. The mingling of convection and conduction discharges is sufficient to account for the phenomenon which Faraday observed. The brush discharge between two terminals becomes disruptive when the negative terminal is moved into contact with the end of the positive column. If the gap is made still shorter, until the distance between the knobs is equal to the length of the Faraday dark space, the critical spark length has been reached.

In the papers referred to, it was suggested that the stria in the Geissler tube were in the nature of vibrations in an organ pipe. This explanation simply involves the assumption that a wave consists of a dark space and an adjoining luminous segment. These are respectively regions of convection and conduction. They are Faraday dark spaces and positive columns. In them the carriers are moving in opposite directions. The nodal planes where pressure is at a maximum and at a minimum alternately both in space and in time, lie between the dark and luminous segments of the waves. At the instant when the pressure is at a maximum and a minimum at adjoining nodes, the convection transfer is zero. The conduction transfer will at that instant be at a maximum and a minimum at consecutive nodes. These conditions may explain the displacement of the striations which have long ago been observed.

FRANCIS E. NIPHER

#### THE INTERNATIONAL GEOLOGICAL CONGRESS AT STOCKHOLM

THE success of any great gathering of geologists may fairly be gauged by the men brought together, by the interest of the problems illustrated on the excursions, by the comfort and the pleasures of the entertainment, and lastly, it would seem, by the papers, conferences and discussions. Measured by all of these standards, the eleventh International Geological Congress, which was held in Stockholm during the month of September, will take a high rank among international scientific gatherings. The number of geologists in attendance was in excess of seven hundred, and the distinction of the names represented was noteworthy. From Germany came such men as Beck, Bergeat, Beyschlag, Credner, Groth, Keilback, v. Koenen, Penck, Rothpletz, Rudolph, Salomon, Sapper, Steinmann, Wahnschaffe and Walther; from Austria-Hungary, Brückner, Diener, v. Cholnoky and Tietze; from Canada, Adams, Coleman and Miller; from Denmark, Stunstrup and Ussing; from Egypt, Hume; from France, Barrois, Prince Roland Bonaparte, Haug, Kilian, Lory, de Margerie and Termier; from Great Britain, Cole, Garwood, Gregory, Horne, Oldham, Peach, Sollas, Strahan and Teall; from Italy, Baldacci, Capellini de Stefani and Mattiolo; from Japan, Inouye; from Mexico, Aguilera and Ordoñez; from Norway, Brøgger, Reusch and Vogt; from Russia, Andrusow, Loewinson-Lessing and Tschernyschew; from Finland, Frosters, Ramsay and Sederholm; from Sweden, Gunnar Andersson, J. G. Andersson, Bäckström, de Geer, Hamberg, Sven Hedin, Högbom, Holmquist, Lindbalm, Moberg, Nathorst, Nordenskiöld and Sernander; from Switzerland, Baltzer, Brunhes, Heim, Lugeon and Schmidt (Carl). The roll from the United States included Bascom (Miss), Becker, Bryant, Cross, Day (A. L.), Emmons, Fenneman, Grabau, Hague, Hobbs, Irving, Kemp, Lindgren, Newland, Reid, Richards, Smith (G. O.), Spencer (J. W.), Tarr, Van Hise, Winchell (H. V.) and Wolff.

The Swedish people enjoy a wide interna-

tional reputation for organization, and this could hardly be better exemplified than by the plans and their execution for the Stockholm congress, in which the general secretary, Professor J. G. Anderssen, has necessarily played the major rôle. The excursions before, during and after the congress were on a large scale, were participated in by an exceptionally large number of persons, and had an interest quite extraordinary. As many of them carried the visiting geologists well within the arctic circle, there was offered the opportunity of studying geological processes peculiar in some sense to sub-polar regions and hence largely new. Of especial importance and interest was the process of salifluction, apparently as characteristic of sub-polar latitudes as stream erosion of more temperate climes. The many quite remarkable manifestations of this process were to be seen by the members taking part in at least two of the excursions. The longest of the excursions, that to Spitzbergen, required over three weeks' time and was participated in by between sixty-five and seventy members of the congress. A grounding of the steamer in the Isfjord might have proved serious, but after a part of the coal had been thrown overboard the ship was again floated at the next high tide. About Torneträsk in northern Sweden, several of the other excursion parties were more or less united. Those interested especially in tectonic questions studied the great overthrusts of the district under the leadership of Professor Holmquist. The positions of the unmoved pre-Cambrian and Silurian beds and the great nappes of overriding crystallines could be discerned for long distances and with unusual clearness from the railroad, which follows the southern shore of the lake. Those more interested in glacial problems studied the successive ice-dammed lakes of late Pleistocene times which were formed against the ice front as it retired southeastwardly through this portal of the mountains. The strand-lines dating from this period are preserved in greater numbers and perfection than are even the famous "parallel roads" of the Scottish glens. The second of

the successive outlets toward the Atlantic is the Bardo Valley, and this was seen from a commanding position which had received no name. This magnificent gorge, while on a smaller scale than that of the Yellowstone, yet is its rival in many respects. The not distant railway station of Abiskojokk bids fair to become in the future a gathering point especially for European tourists, and the geologists of excursion A<sub>4</sub> unanimously voted that the beautiful point of inspiration from which the gorge was viewed be named *Point Sjögren*, in honor of Dr. Otto Sjögren, the leader of the excursion. Several of the large excursions included a visit to the great iron ores of the Kirunavaare district in northern Lapland, and many availed themselves of the opportunity to return to Stockholm by way of the northwest coast of Norway, with its many morphological and scenic attractions. In the Jämtland excursion, Dr. Högbom, the leader, was so unfortunate as to suffer a fracture of the arm, which compelled him to give over the conduct of the party, but did not prevent his attending the congress and taking charge of other excursions. One other accident marred the pleasure of the excursions. Professor Sapper, of Strassburg, was run down by a cyclist at the station of Are and his left arm broken and dislocated at the shoulder.

The complete list of the excursions is as formidable as the Livret-guide to explain them. This latter comprised no less than forty monographs, for the most part written with admirable adaptability to the end in view. These concise summaries of the geology of representative districts by the best authorities upon them, are being more and more highly appreciated by geologists, as is shown by the number who subscribe to the congress without attending its sessions. In addition to the Livret-guide a vast amount of literature was presented to members, and as most of it was valuable the manner of its transportation to the distant homes became sometimes an important problem for the visiting geologists.

Not least important of the acts of the Swedish committee of the congress has been

the discovery and use of a new method of conducting international investigations. As is well known, the method of appointing international commissions has, with one or two notable exceptions, proved ineffective. Such commissions were made to include the authorities in many countries, and for obvious reasons such a body proved too unwieldy for effective work. When it was possible to bring them together, discussion took the place of legislation, and authority to proceed along any definite line was wanting. In the Swedish plan the unwieldy commission is replaced by the council of the congress, whose responsibility is evident and whose interest to make the undertaking successful is immediate and acute. Having responsibility, they may delegate to any man or selected body of men both the general plan and the working out of the details of the inquiry. The permanent results of the inquiry take the form of a published report consisting of individual and generally brief summary reports from specialists in many countries, written in any of the four recognized languages of present-day science, the entire report introduced by a general summary of the reports written by a recognized authority who is essentially the leader in the inquiry. The volumes are edited by the general secretary of the congress.

The initial products of this system of international inquiry into geological problems are two reports of great value, one dealing with the iron-ore resources of the world and comprising two quarto volumes and an atlas, the other a large volume devoted to the changes in climate since the maximum of the last ice-period. It is proposed to employ the same method in an inquiry concerning the fracture systems of the earth's crust—the systems of joints particularly—as regards their orientation and interrelations.

The Swedish geologists had determined that the subjects especially discussed in the sessions should be those of most importance to their own country and also (in part) illustrated by the excursions. Two of these have already been discussed as the titles of the works issued at the opening of the congress,

viz., the iron-ore resources of the world and post-glacial climatic changes. Three additional subjects were chosen: (1) the geology of the pre-Cambrian formations with special reference to principles of classification and to deep-seated metamorphism; (2) the sudden appearance of the Cambrian fauna, and (3) the geology of the polar regions.

In addition to the formal ceremonies of the opening general session, there were read two papers which had a bearing upon the two most important topics of the congress. Baron de Geer with the aid of lantern slides sketched the outlines of his "geochronology of the last 12,000 years" based upon the study of the banded clay deposits in relation to the minor moraines of Sweden which are traced on either side of the Stockholm Os. The individual colored bands in the clay deposit, the *hvarfving lera*, are believed to represent each the deposit of a single year within the submarine mouth of a former subglacial river of which the Os marks the course. Likewise there is a series of low but well-formed black moraines a few meters only in height and about 250 meters apart, which correspond each to a definite clay layer present on the south but lacking on the north and thus representing the delta deposit of the subglacial river for that year when the seasonal halt of the ice-front in its retreat laid down the moraine. With the aid of a number of students during many years, de Geer has worked out the entire series and thus derived the chronology. Two large excursion parties were taken into the field during the session of the congress, and some attempt was made to check the change in the number of clay layers at successive excavations separated by moraines. While this could not be wholly satisfactory in the time available, the methods of this novel and important investigation were learned and a corresponding profound respect was acquired for the ingenuity of plan and thoroughness of execution of the whole investigation—an investigation unique of its kind and one which will probably be followed by others in distant regions.

The other general address was by Professor Van Hise, on "The Influence of Applied Geol-

ogy and the Mining Industry upon the Economic Development of the World." This address sketched in broad lines the evolution of mine exploitation and in forceful manner presented the doctrine of conservation as applied to mineral resources, but especially to iron and coal.

The conferences and sectional meetings were so separated by excursions and by social or other events as to exert but little strain upon the members in attendance. The effect was apparent in the general good temper of the participants. The congress was formally opened on Thursday (August 18). On Friday morning those interested especially in pre-Cambrian geology joined an excursion to study the Archean of the vicinity of Stockholm, and in the afternoon they assembled in several sections for the reading of papers. The glacial geologists, on the other hand, devoted the morning to papers on glacial erosion, and in the afternoon studied the "hvarfvig lera" of the neighborhood under the leadership of de Geer. Saturday was given over entirely to papers, Sunday to an excursion to Upsala, Monday to papers, Tuesday to excursions of various kinds, Wednesday in turn to papers and Thursday, finally, to a general session on polar exploration and to the closing ceremonies. All notices except such as related to actions of the council were clearly and concisely given in a little book of convenient pocket size, which, if one had always with him, he needed to ask no questions in order to learn the time or place of any event. A list of the papers read by American and Canadian geologists in attendance follows:

F. D. Adams, "The Origin of the Deep-seated Metamorphism of the pre-Cambrian Crystalline Schists."

A. P. Coleman, "Metamorphism in the pre-Cambrian of Northern Ontario."

Wm. H. Hobbs, "Fracture Systems of the Earth's Crust."

H. F. Reid, "Faults and Earthquakes."

R. S. Tarr, "The Advance of Glaciers in Alaska as a Result of Earthquake Shaking."

W. G. Miller, "The Principles of Classification of the pre-Cambrian Rocks, and the

Extent to which it is Possible to Establish a Chronological Classification."

J. F. Kemp, "Archean Rocks of the Adirondack Area."

A. P. Coleman, "Methods of Classification of the Archean of Ontario."

A. W. Grabau, "Ueber die Einteilung des nord-amerikanischen Silurs." Also, "Continental Sediments in the North American Paleozoic."

F. D. Adams, "An Experimental Investigation into the Flow of Rocks."

A. L. Day, "Are Quantitative Physico-chemical Studies of Rocks Practicable?"

A. P. Coleman, "The Lower Huronian Ice Age."

H. G. Ferguson, "Mineral Resources of the Philippine Islands."

A number of important matters were settled by the council of the congress and announced at the closing session. The invitation of Canada to hold the next session in the dominion in 1913 was unanimously approved after the invitation of Belgium had been withdrawn. The council expressed its belief that the congress of 1916 should be held in Belgium. A proposition offered by Director G. Otis Smith for the preparation of a standard geological map of the world on the scale of one to one million was left in the hands of a committee consisting of Messrs. Beyschlag, Smith, Suess, Teall and Tschernyschew to present a plan at the next congress. The council recommended that the executive committee of the next congress take up an international investigation of the fracture systems of the earth's crust and publish a report in the manner so successfully prosecuted for the iron-ore resources and the post-glacial climatic changes. Professor Beyschlag reporting for the commission of the geological map of Europe announced that the sheets covering Central Europe are now out of print and that the commission has decided to issue a new edition of them. Messrs. Brock, Smith, Willis, Aguilera, Keidel and David were added to the commission.

WM. HERBERT HOBBS

STOCKHOLM,

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